

SMAP Mission Applications

*3rd Canadian SMAP Workshop
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SMAP Mission Overview

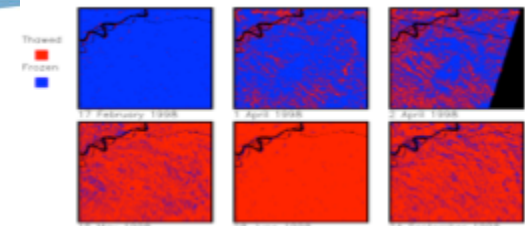
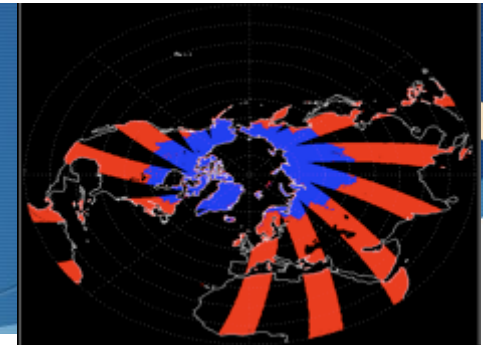
The proposed SMAP mission was in the first tier recommended by 2007 NRC Earth Science Decadal Survey

Primary Science Objectives :

Global, high-resolution mapping of soil moisture and its freeze/thaw state to:

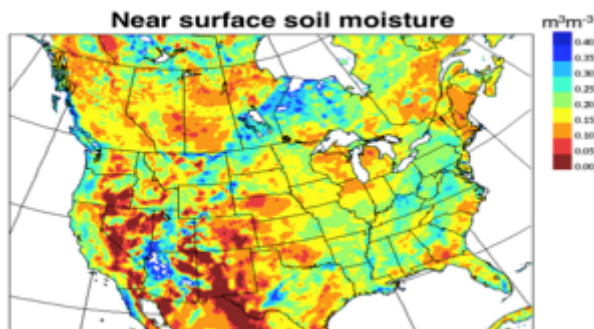
- Link terrestrial water, energy and carbon cycle processes
- Estimate global water and energy fluxes at the land surface
- Quantify net carbon flux in boreal landscapes
- Extend weather and climate forecast skill
- Develop improved flood and drought prediction capability

Freeze/thaw state



Proposed Mission Implementation:

SMAP will launch 31 October 2014



Partners	<ul style="list-style-type: none"> • JPL (project & payload mgmt, science, spacecraft, radar, mission operations, science processing) • GSFC (science, radiometer, science processing)
Risk	<ul style="list-style-type: none"> • 7120.5D Category 2; 8705.4 Payload Risk Class "C"
Launch	<ul style="list-style-type: none"> • Oct. 31, 2014, the baseline plan launch vehicle is Delta-2
Orbit	<ul style="list-style-type: none"> • Polar sun synchronous; 685 km altitude
Duration	<ul style="list-style-type: none"> • 3 years
Payload	<ul style="list-style-type: none"> • L-band SAR (JPL) • L-band radiometer (GSFC) • Shared 6m rotating (13 rpm) antenna (JPL)



Proposed SMAP Mission Products

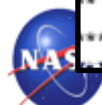


Product	Description	Gridding (Resolution)	Latency*	
L1A_TB	Radiometer Data in Time-Order	-	12 hrs	Instrument Data
L1A_S0	Radar Data in Time-Order	-	12 hrs	
L1B_TB	Radiometer T_B in Time-Order	(36x47 km)	12 hrs	
L1B_S0_LoRes	Low Resolution Radar σ_0 in Time-Order	(5x30 km)	12 hrs	
L1C_S0_HiRes	High Resolution Radar σ_0 in Half-Orbits	1 km (1-3 km)***	12 hrs	
L1C_TB	Radiometer T_B in Half-Orbits	36 km	12 hrs	
L2_SM_A**	Soil Moisture (Radar)	3 km	24 hrs	Science Data (Half-Orbit)
L2_SM_P	Soil Moisture (Radiometer)	36 km	24 hrs	
L2_SM_AP	Soil Moisture (Radar + Radiometer)	9 km	24 hrs	
L3_FT_A	Freeze/Thaw State (Radar)	3 km	50 hrs	Science Data (Daily Composite)
L3_SM_A**	Soil Moisture (Radar)	3 km	50 hrs	
L3_SM_P	Soil Moisture (Radiometer)	36 km	50 hrs	
L3_SM_AP	Soil Moisture (Radar + Radiometer)	9 km	50 hrs	
L4_SM	Soil Moisture (Surface and Root Zone)	9 km	7 days	Science Value-Added
L4_C	Carbon Net Ecosystem Exchange (NEE)	9 km	14 days	

* The SMAP Project will make a best effort to reduce the data latencies beyond those shown in this table

** Research product with possible reduced accuracy

*** Over Outer 70% of Swath



Why does the SMAP Mission have an Applications Plan?

NASA Authorization Act of 2005 (P.L. 109-155)

SEC. 313. PILOT PROJECTS TO ENCOURAGE PUBLIC SECTOR APPLICATIONS

“The Administrator shall establish a program of grants for competitively awarded pilot projects to explore the integrated *use of sources of remote sensing and other geospatial information to address State, local, regional, and tribal agency needs.*

Sec. 314(a): The Administrator shall *establish an advisory committee*, consisting of individuals with appropriate expertise in State, local, regional, and tribal agencies, the university research community, and the remote sensing and other geospatial information industries, to monitor the program established under section 313.”



National Research Council Decadal Survey Report

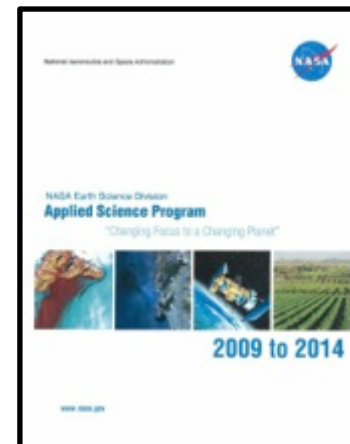
EARTH SCIENCE AND APPLICATIONS FROM SPACE

“A fundamental challenge for the coming decade is to ensure that established societal needs help to guide scientific priorities more effectively and that emerging scientific knowledge is actively applied to obtain societal benefits. New observations and analyses, ... *broadened community participation and improved means for dissemination and use of information are all required.*”

NASA Earth Sciences Division

APPLIED SCIENCES PROGRAM STRATEGIC PLAN

Goal to “evaluate the potential for current and planned NASA missions to meet societal needs through applied sciences participation in mission science teams” and provide Mission applications support to “*integrate applications needs into mission planning.*”



SMAP Applications Program



- A primary goal of the SMAP Mission is to **engage SMAP end users** and **build broad support** for SMAP applications through a transparent and inclusive process
- Toward that goal, the SMAP Mission:
 - Formed the SMAP Applications Working Group
 - Currently over 300 members
 - Produced a Formal SMAP Applications Plan (A living document)
- The Objectives of the SMAP Application Working Group:
 - Communicate with User Community
 - Facilitate between Users and SMAP SDT
 - *Societal needs and information are addressed to maximize mission product design at inception*
 - Demonstrate added value through feedback loops and workshops that engage all users (science, business and policy)
 - Coordination with other international programs and missions (ESA, SMOS, Aquarius) to improve the outcome of mission products.



SMAP Applications Plan

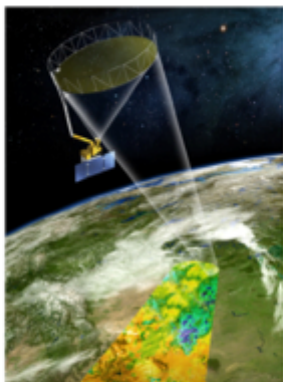


The SMAP Applications Plan is a living document.



National Aeronautics and Space Administration
Goddard Space Flight Center, Greenbelt, MD

Soil Moisture Active Passive (SMAP) Mission Applications Plan



Edited by:

Molly Brown¹, Susan Moran², Vanessa Escobar³, Dara Entekhabi⁴

¹SMAP Applications Coordinator, ²SMAP Applications Working Group Chair, ³Deputy SMAP Applications Coordinator, ⁴SMAP Science Definition Team Leader

- “This plan provides an *implementation strategy for promoting applications research and engaging a broad community of users in SMAP applications.*”

- *Implementation Strategy*

- 1) Engagement with Early Adopters
- 2) Promotion of Community of Potential
- 3) SMAP Applications Research, possibly funded by ROSES call
- 4) Coordination with SMAP Cal/Va1
- 5) Coordination with other DS Missions

- *SMAP Applications are led by:*

-Molly Brown, SMAP Applications Coordinator

-Vanessa Escobar, SMAP Applications Deputy Coordinator

-Susan Moran, Chair, SMAP Applications Working Group



<http://smap.jpl.nasa.gov/>

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What is an Application?



Applications are defined as innovative uses of mission data products in decision-making activities for societal benefit.

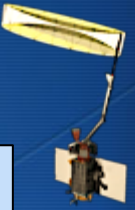
Applications research will provide fundamental knowledge of how mission data products can be scaled and integrated into users' policy, business and management activities to improve decision-making efforts.

User Community includes

- individuals or groups
- public or private sectors
- national or international organizations
- local to global scales of decision making



Engagement with Early Adopters



What is an Early Adopter?

Early Adopters are defined as those groups or individuals who have a clearly defined need for SMAP-like soil moisture or freeze/thaw data and who have sufficient interest and personnel to demonstrate the utility of SMAP data for their particular application.

Recall that applications are defined as innovative uses of SMAP data products in [decision-making activities for societal benefit](#).

Why are we engaging Early Adopters?

To conduct *[pre-launch applications research](#)* to accelerate the use of SMAP products after the launch of SMAP

How are we engaging Early Adopters?

- SOA
- Application for Access to Pre-launch SMAP Simulated and Cal/Val Data (unfunded, immediate)
- ROSES RFP (funded in late 2012)



Early Adopter Process



Statement of Activity (SOA): an unfunded partnership

- Request for nominations/recommendations through the SMAP AppWG
- Nomination process is submission of 1-page application
 - Description, Approach, Requirements
 - We reviewed the proposals and selected those qualified
- SMAP commitment
 - Provide simulated SMAP data products
 - Provide access to cal/val data
- Early Adopter commitment
 - Conduct applications research
 - Join the SMAP Applications Team
 - Attend SMAP Applications Workshops to report results
- ***Total of 19 selected. Continuing EA selections through launch***



SMAP Early Adopters 2011-2013



SMAP Early Adopters	
Investigator and Institution	Applications Research Topic
Selected in 2011	
Stephane Belair , Meteorological Research Division, Environment Canada (EC)	<i>Assimilation and impact evaluation of observations from the SMAP mission in Environment Canada's Environmental Prediction Systems</i>
Hosni Ghedira , Masdar Institute, UAE	<i>Estimating and mapping the extent of Saharan dust emissions using SMAP-derived soil moisture data</i>
Zhengwei Yang and Rick Mueller , USDA National Agricultural Statistical Service (NASS)	<i>U.S. National cropland soil moisture monitoring using SMAP</i>
Catherine Champagne , Agriculture and Agri-Food Canada (AAFC)	<i>Soil moisture monitoring in Canada</i>
Amor Ines and Stephen Zebiak , International Research Institute for Climate and Society (IRI) Columbia University	<i>Seasonal climate forecasts with dynamic crop simulation models for crop forecasting and food security early warning applications</i>
Lars Isaksen and Patricia de Rosnay , European Centre for Medium-Range Weather Forecasts (ECMWF)	<i>Monitoring SMAP soil moisture and brightness temperature at ECMWF</i>
Xiwu Zhan, Michael Ek and John Simko , NOAA National Environmental Satellite Data and Information Service, Center for Satellite Applications and Research (NOAA-NESDIS-STAR)	<i>Transition of NASA SMAP research products to NOAA operational numerical weather and seasonal climate predictions and research hydrological forecasts</i>

SMAP Early Adopters	
Selected in 2012	
Curt Reynolds , USDA Foreign Agricultural Service (FAS)	<i>Enhancing USDA's global crop production monitoring system using SMAP soil moisture products</i>
John Eylander , U.S. Army Engineer Research and Development Center (ERDC) Cold Regions Research and Engineering Laboratory (CRREL)	<i>U.S. Army Engineer Research and Development Center (ERDC) SMAP adoption for USACE civil and military tactical support</i>
Jim Reardon and Gary Curcio , US Forest Service (USFS)	<i>Wildfire danger and estimated smoldering potential in the organic soils of the North Carolina coastal plain</i>
Gary McWilliams, Li Li, Andrew Jones and George Mason , Dept. of Defense - Soil Moisture Applications Consortium (SMAC)	<i>Exploitation of SMAP data for Army and Marine Corps mobility assessment</i>
Michael Ek, Marouane Temimi, Xiwu Zhan , NOAA National Centers for Environmental Prediction (NCEP)	<i>Integration of SMAP freeze/thaw product into the NOAA NCEP weather forecast models</i>
John Galantowicz , Atmospheric and Environmental Research, Inc. (AER)	<i>Use of SMAP-derived inundation and soil moisture estimates in the quantification of biogenic greenhouse gas emissions</i>
Jingfeng Wang, Rafael Bras and Aris Georgakakos , Georgia Institute of Technology (GIT)	<i>Application of SMAP observations in modeling energy/water/carbon cycles and its impact on weather and climatic predictions</i>
Kyle McDonald , City College of New York (CUNY) and CREST Institute, and Don Pierson , New York City Dept. of Environmental Protection	<i>Application of SMAP freeze/thaw and soil moisture products for supporting management of New York City's potable water supply</i>
Chris Funk, Amy McNally and James Verdin , US Geological Survey & UC Santa Barbara	<i>Incorporating soil moisture retrievals into the Famine Early Warning System (FEWS) Land Data Assimilation System (FLDAS)</i>
Fiona Shaw , Willis, Global Analytics	<i>eNCOMPASS - A risk identification and analysis system for insurance; Multiple catastrophe risk models, risk rating tools and risk indices for insurance and reinsurance purposes including a Global Flood Model</i>
Rafael Ameller , StormCenter Communications, Inc.	<i>SMAP for enhanced decision making (emergency management)</i>
Selected in 2013	
Jonathan Case and Clay Blankenship , Marshall Space Flight Center and Universities Space Flight Center	<i>Application of Next-Generation Satellite Data to a High-Resolution, Real-Time Land Surface Model with SMAP.</i>

Opportunity for 2013 EAs is open!



<http://smap.jpl.nasa.gov/>

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SMAP Early Adopter SDT Partners

The SMAP EA program is about fostering relationships between the Mission scientist and the user community

- An SDT member volunteers to work and guide EA research
- EA provides feedback and lessons learned to the mission through the SDT member.
- Mission research will be better applied and understood by the time SMAP launches.

Early Adopter PI and Institution	SMAP Project Partner
Selected in 2011	
Stephane Belair, Meteorological Research Division, Environment Canada (EC)	Stephane Belair
Hosni Ghedira, Masdar Institute, UAE	Dara Entekhabi
Zhengwei Yang and Rick Mueller, USDA National Agricultural Statistical Service (NASS)	Wade Crow
Catherine Champagne, Agriculture and Agri-Food Canada (AAFC)	Stephane Belair
Amor Ines and Stephen Zebiak, International Research Institute for Climate and Society (IRI) Columbia University	Narendra Das
Lars Isaksen and Patricia de Rosnay, European Centre for Medium-Range Weather Forecasts (ECMWF)	Patricia de Rosnay
Xiwu Zhan, Michael Ek and John Simko, NOAA National Environmental Satellite Data and Information Service, Center for Satellite Applications and Research (NOAA-NESDIS-STAR)	Randy Koster

Early Adopter PI and Institution	SMAP Project Partner
Selected in 2012	
Curt Reynolds, USDA Foreign Agricultural Service (FAS)	Wade Crow
John Eylander, U.S. Army Engineer Research and Development Center (ERDC) Cold Regions Research and Engineering Laboratory (CRREL)	Susan Moran
Jim Reardon and Gary Curcio, US Forest Service (USFS)	Dara Entekhabi
Gary McWilliams, Li Li, Andrew Jones and George Mason, Dept. of Defense - Soil Moisture Applications Consortium (SMAC)	Susan Moran
Michael Ek, Marouane Temimi, Xiwu Zhan, NOAA National Centers for Environmental Prediction (NCEP)	Kyle McDonald
John Galantowicz, Atmospheric and Environmental Research, Inc. (AER)	John Kimball
Jingfeng Wang, Rafael Bras and Aris Georgakakos, Georgia Institute of Technology (GIT)	Dara Entekhabi
Don Pierson, New York City Dept. of Environmental Protection	Kyle McDonald
Chris Funk, Amy McNally and James Verdin, US Geological Survey & UC Santa Barbara	Molly Brown
Fiona Shaw, Willis, Global Analytics	Robert Gurney
Rafael Ameller, StormCenter Communications, Inc.	Randy Koster
Selected in 2013	
Johnathan Case, NASA Marshall Space Flight Center and Clay Blankenship, Universities Space Research Association	Susan Moran



Examples of SMAP Early Adopter Research

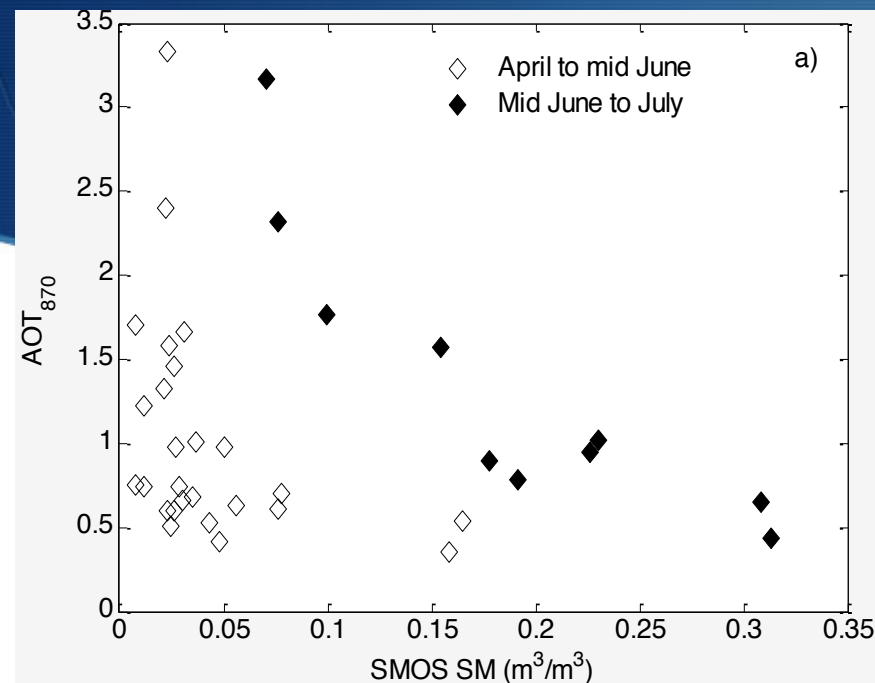


Effect of the soil moisture on dust emission

Hosni Ghedira, Masdar Institute, UAE

Cinzana AERONET AOT870 measurements versus SMOS soil moisture **orange between 0 and 0.35m³/m³**

Finding: as SMOS soil moisture increases, the AERONET aerosol optical thickness (AOT) decreases up to a threshold moisture content above which no dust emission takes place

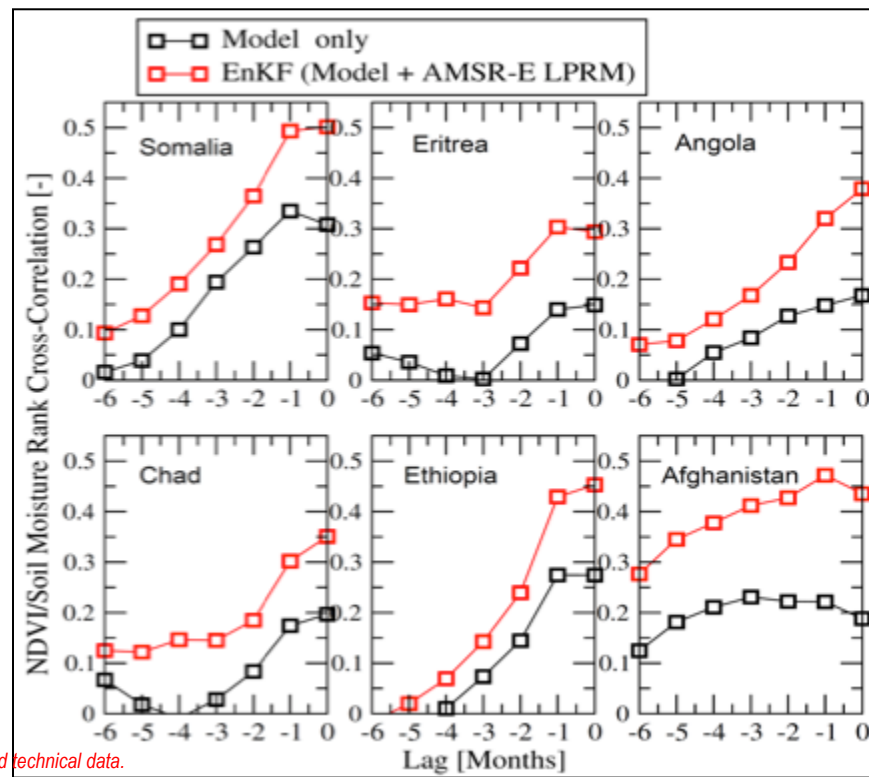


FAS Global Agricultural Drought Monitoring 2002-2010 Performance in Data-Poor Regions

Curt Reynolds, USDA Foreign Agricultural Service (FAS)

Prepare USDA FAS modeling system for the ingestion of SMAP L2/3 and/or L4 products.

6 of the 10 most “food insecure” countries in 2011.



SMAP Survey Findings, 2012



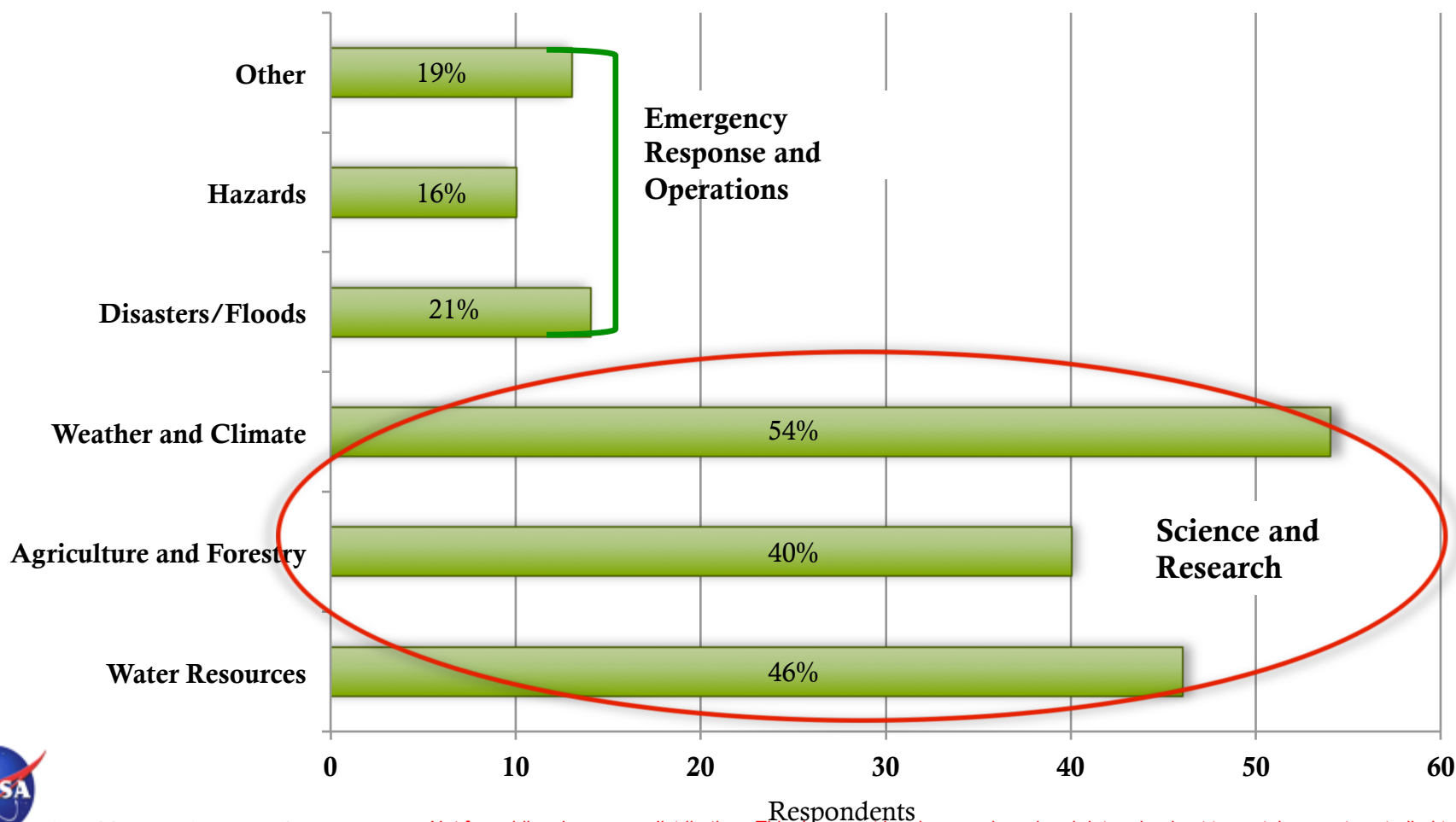
- ◆ Gap between research and policy applications
- ◆ High perceived value of soil moisture
- ◆ Uncertainty as to how ground observations will scale to remotely sensed data
- ◆ Where to access SMAP-like data



Representative Communities



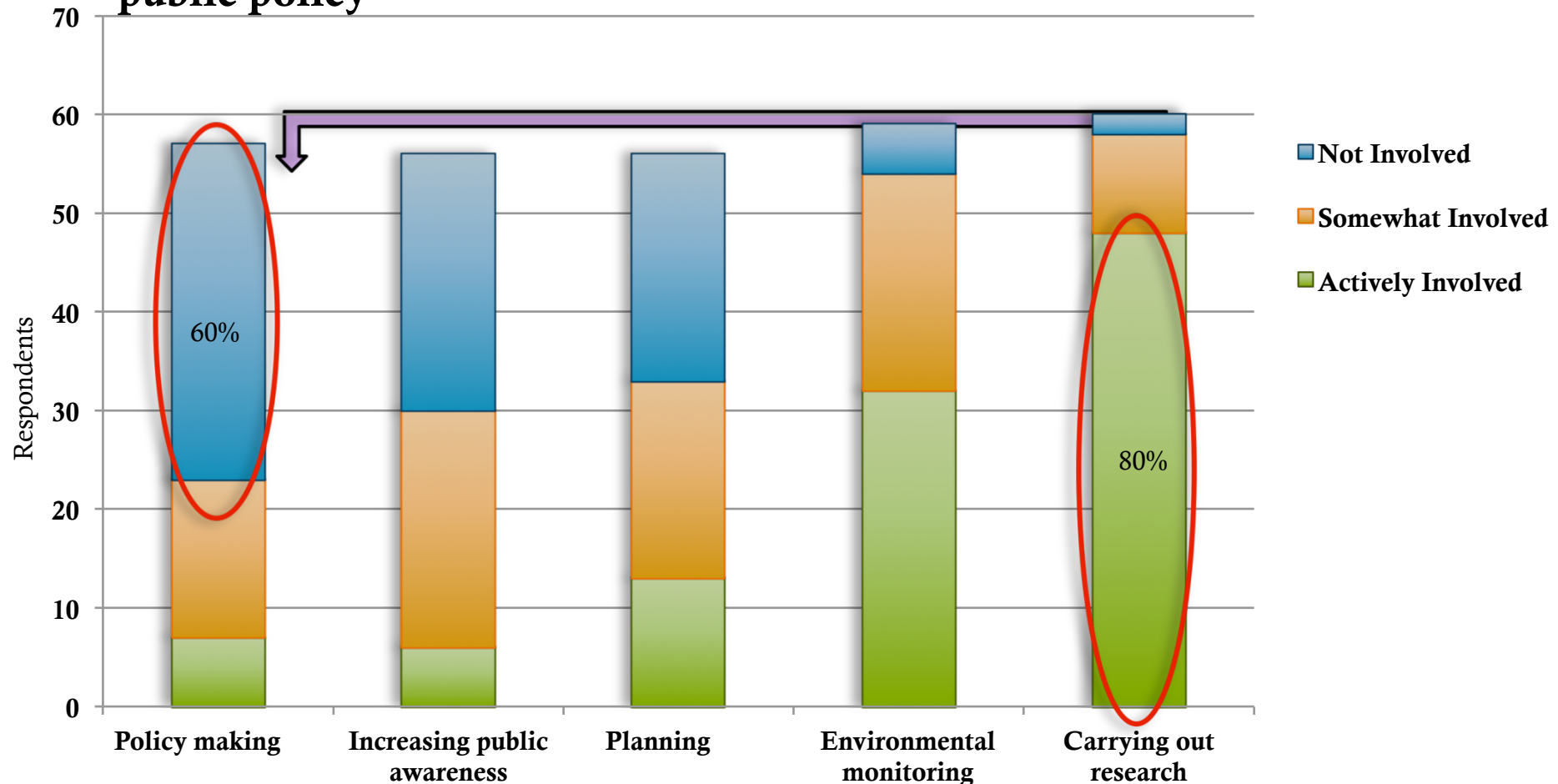
- Results show most users associated with SMAP are research/science users.
- Operational users were under represented...why?



Science research vs. applications



■ Carrying out research vs. involvement with decision making and public policy



SMAP Application Activities



SMAP Applications Activities

2009	2010	2011	2012	2013	2014
Events					
First SMAP Applications Workshop at NOAA		Second SMAP Applications Workshop at USGS	SMAP Focus Session at Palo Verde Nuclear Power Plant	SMAP Application Workshop on Health	3 rd SMAP Applications Workshop
		SMAP USDA Focus Session	SMAP Focus Session for Arizona State University Urban Modeling Community	Focus Session with Willis and Lloyd's Reinsurance, London	SMAP/SMOS Tutorial at AMS
		SMAP DoD Focus Session	First Joint Mission Tutorial with SMAP/ICESat-2		SMAP DoD Focus Session-Military Mobility
			SMAP/GRACE/GPM and SWOT Joint Mission Tutorial		Lloyds of London Flood Modeling and Policy Focus Session
Event Outcomes: User Driven Product Development					
			Sea Ice Product development with Dept. of Navy, NRL, SMAP and ICESat-2	Permafrost Product for Alaska (planning)	
			1km product for the regional Alaska area (planning)	SMAP Mobility product in Afghanistan (planning)	
			Emergency Operation Product Development during Table Top Exercise	Soil moisture collaboration in Las Serenas, Chile and ACE. Analysis of soil moisture impacts on agriculture (wine production)	



Other SMAP Application Efforts



- Conduct meetings and workshops at the necessary levels to bring thematic users relevant and valued information for their applications
- Communicate Applications framework successes and requirements to NASA HQ.
- Coordinate with SMAP CAL/VAL activities and data availability
- Identify new opportunities for user/product development from within user community
- Joint Publications on SMAP applications and SMAP Test Bed
- Prepare for Post Launch Research and Early Adopter transition
- Conduct reports and updates for mission to the SMAP user community
- Document lessons learned and quantify value of Mission Applications to NASA



SMAP is redefining how NASA executes mission applications



SMAP leads by engagement and application actions:

- Developed an **Applications Plan**
- Informing and expanding the **Applications Working Group (AppWG)**.
- Appointed a dedicated **SMAP Applications Team** as part of the mission SDT
- Formed three levels of engagement with applications partners (1. Workshops, 2. Tutorials and 3. Focus Groups)
- Collaborate with Key agencies (so far NOAA, USGS, USDA)
- Actively expanding application efforts internationally: Canada, UK, Chile, Argentina, Africa, France, Spain, Australia.
- Continuing calls for **Early-Adopters** to engage with SDT and project to demonstrate value of SMAP data to their decision support systems early on
- Co-organize workshops across Decadal Survey missions (SMAP-ICESat2 and SMAP-GPM-GRACE/FO-SWOT)



Summary



- Applications are a substantive component of the SMAP mission
- Applications research results in fundamental knowledge
- There is a growing team within/outside SMAP dedicated to SMAP applications
- The SMAP Early Adopters are providing valuable feedback to the mission on how SMAP data will be used after launch
- Early mission research has identified areas where the mission can improve data format and data access to broaden the community of users (i.e. emergency operations, health)





Questions?

